

Pulkovo IVS Analysis Center (PUL) 2011 Annual Report

Zinovy Malkin

Abstract

This report briefly presents the PUL IVS Analysis Center activities during 2011 and plans for the coming year. The main topics of the investigations of the PUL staff in that period were ICRF related studies, computation and analysis of EOP series, celestial pole offset (CPO) modelling, and VLBI2010 related issues.

1. General Information

The PUL IVS Analysis Center (AC) was organized in September 2006 and is located at and sponsored by the Pulkovo Observatory of the Russian Academy of Sciences. It is a part of the Pulkovo EOP and Reference Systems Analysis Center (PERSAC) [1]. The main topics of our IVS related activities are:

- Improvement of the International Celestial Reference Frame (ICRF).
- Computation and analysis of the Earth orientation parameters (EOP) from Intensives and 24-hour IVS sessions.
- Modelling of the celestial pole offset (CPO) and free core nutation (FCN).
- Comparison of VLBI products, primarily as Earth orientation parameters (EOP), with results of other space geodesy techniques.
- Computation and analysis of observation statistics.

The PUL AC's Web page [2] is supported. It contains the following sections:

- *General Information on the PUL AC.* Includes brief history, activity overview, and scientific staff list.
- *VLBI data analysis.* Includes results of VLBI data analysis, such as CPO/FCN series, UT1 Intensives series, and mean Pole coordinates. Data are updated daily.
- *OCARS catalog.* Includes the latest version of the catalog of optical characteristics of astrometric radio sources (OCARS) [3]. The catalog is continually updated as new information becomes available.
- *Approaches and occultations.* Includes tables for forthcoming mutual events of planets and astrometric radio sources, such as close angular approaches and occultations for the period until 2050 [4].
- *PUL members' publications and presentations.*
- *VLBI technology overview.*
- *Links to the VLBI World.* Includes links to (primarily geodetic and astrometric) VLBI coordinating bodies, stations, analysis centers, software, etc.
- *Contact information.*

2. Scientific Staff

In 2011 the following persons contributed to the PUL activity:

1. Zinovy Malkin (70%) — PUL coordinator, EOP and CRF analysis
2. Natalia Miller (10%) — EOP analysis
3. Julia Sokolova (10%) — CRF analysis

3. Activities and Results

The main activities and results of the PUL IVS Analysis Center during 2011 included:

- Operational processing of the IVS Intensive sessions in automated mode and submission of results to IVS was continued.
- ICRF related research was continued. The main directions of this activity were comparison and combination of radio source catalogs, and investigation of their stochastic and systematic errors.
- The work on the OCARS catalog [3] was continued. The current basic statistics of the catalog is the following:

	OCARS	ICRF2	ICRF2 def.
Sources	6431	3414	295
Sources with known redshift	3167 (49.2%)	2072 (60.7%)	253 (85.8%)
Sources with known optical magnitude	4132 (64.3%)	2541 (74.4%)	284 (96.3%)

- A catalog of approaches of planets to radio sources and occultations of astrometric radio sources by planets through the year 2050 was updated [4].
- Investigations of CPO modelling and its impact on data processing were continued. The main activities and results in 2011 are the following:
 - The PUL CPO and FCN series are updated daily.
 - The results of comparing the CPO and FCN models were published [5]. In this paper, several publicly available empirical models of the celestial pole offset (CPO) and free core nutation (FCN), including those developed by the author, were investigated and compared to each other from different points of view, such as representation of the observational data, FCN parameter variation, and prediction accuracy. Based on this study, some practical recommendations were proposed.
 - The impact of celestial pole offset modelling on VLBI UT1 Intensive results was studied [6]. In this study, three CPO models currently available for users were tested and the differences between UT1 estimates obtained with those models were investigated. It was shown that neglecting CPO modelling during VLBI UT1 Intensive processing causes systematic errors in UT1 series of up to 20 μ as. It was also found that using different CPO models causes differences in UT1 estimates reaching 10 μ as. The obtained results are applicable to the satellite data processing as well.

- A preliminary study of the impact of the Galactic aberration on VLBI-derived precession parameters has begun [7]. It has been shown by comparison of the linear trends in the coordinates of the celestial pole obtained with and without taking into account the Galactic aberration that this effect can reach $20 \mu\text{as}/\text{cy}$. It is also shown that correcting for the Galactic aberration influences the derived parameters of low-frequency nutation terms. It is therefore necessary to correct for Galactic aberration in the reduction of modern astrometric observations.
- The PUL archive of VLBI data and products is supported. At present, all available databases and corresponding NGS cards for 1979 – 2011 have been stored (about 9.4 million observations) along with the main IVS and IERS products. These archives are continually updated as new databases become available.
- The development of algorithms and software for data processing and analysis was continued.
- PUL staff members participated in the activities of several IERS, IAG, and IVS projects, committees, and working groups.

4. Outlook

Plans for the coming year include:

- Continue VLBI related studies.
- Continue UT1 Intensive processing.
- Continue OCARS catalog support.
- Continue development of algorithms and software for data processing.
- Continue support of the PUL archives of data and products.

References

- [1] <http://www.gao.spb.ru/english/as/persac/index.htm>
- [2] http://www.gao.spb.ru/english/as/ac_vlbi/
- [3] http://www.gao.spb.ru/english/as/ac_vlbi/ocars.txt
- [4] http://www.gao.spb.ru/english/as/ac_vlbi/occultations_approaches.pdf
- [5] Malkin Z. M. Comparison of CPO and FCN empirical models. In: Proc. Journees 2010: New challenges for reference systems and numerical standards in astronomy, Paris, France, 20-22 Sep 2010, ed. N. Capitaine, Paris, 2011, pp. 172–175
- [6] Malkin Z. The impact of celestial pole offset modelling on VLBI UT1 intensive results. *J. of Geodesy*, 2011, v. 85, No. 9, 617-622. DOI 10.1007/s00190-011-0468-9
- [7] Malkin Z. M. The Influence of Galactic Aberration on Precession Parameters Determined from VLBI Observations. *Astronomy Reports*, 2011, Vol. 55, No. 9, 810–815. DOI: 10.1134/S1063772911090058